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EXAMINER	
TSOY, ELENA	
ART UNIT	**PAPER NUMBER**
1762	

DATE MAILED: 07/15/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/914,204	MACNEIL ET AL.	
	Examiner	Art Unit	
	Elena Tsoy	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 June 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,5 and 10-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,5 and 10-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

Request for Reconsideration

1. The Examiner confirms that during the interview she agreed to withdraw all the rejections of record. The Examiner has conducted a new search taking into account Applicants' explanations. The new Action is as follows:

Status of claims

2. Claims 2, 4, 6-9 have been cancelled. Claims 1, 3, 5, 10-26 are pending in the application.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington,* 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

4. **Claims 1, 3, 5, 10-20** stand rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 2, 3, 7, 8, 15, 20, 31 of U.S. Patent No. 6,544,858 in view of Tsukune et al (US 5,314,724) for the reasons of record as set forth in Paragraph No. 4 of the Office Action mailed on May 24, 2004.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Rejection of claims 1, 3, 5, 12, 14, 17-25 under 35 U.S.C. 102(b) as being anticipated by Tsukune et al (US 5,314,724) has been withdrawn.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Rejection of claims 1, 3, 5, 10-26 under 35 U.S.C. 103(a) as being unpatentable over Li (US 6,383951) in view of Tsukune et al (US 5,314,724) has been withdrawn.

9. Claims 1, 3, 5, 10-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li (US 6,383951) in view of Tamura et al (US 5,897,923) and Tsukune et al (US 5,314,724).

Li discloses a method of processing a polymer layer including Si-C bonds (See column 4, lines 23-24) deposited on a substrate such as silicon (semiconductive) wafer (See column 1, line 14; column 7, lines 28-29) by CVD in a conventional plasma treatment device (See column 4, lines 26-27) from TEOS (See column 6, lines 14-23), or methyl silane and oxygen source (See column 4, lines 28-41), comprising plasma treating the deposited polymer layer using oxygen (See column 5, lines 11-13) while heating the polymer layer (See column 5, lines 57-58) to temperature of 400^0C -800^0C (See column 5, lines 46-50) to desorb moisture (See column 6, lines 3-5), and exposing the layer to a plasma such as oxygen plasma for 5-90 seconds (See column 5, lines 11-16) during the heating process (See column 5, lines 57-61). The dielectric constant of the processed polymer layer is below 3.00 (See column 6, lines 8-10). The substrate on which the polymer layer is formed may be supported on a pedestal (platen) including heating resistive

heating elements (See column 5, lines 60-63). RF power of between about 0.1 kW and 1 kW, more preferably about 0.5 kW was applied to the electrodes of a plasma reactor (See column 5, lines 31-37).

Li fails to teach that: (i) in the conventional plasma treatment device the substrate is supported on the electrode and the plasma is maintained by RF power source connected to the electrode (Claim 1); (ii) the treating plasma is hydrogen plasma (Claim 1); (iii) hydrogen plasma is further generated in ICP mode concurrently with RIE mode (Claim 26).

As to (i), Tamura et al teach an example of conventional plasma treatment device described with reference to FIG. 12 (See column 1, lines 11-19) where a substrate holder 42 supporting a substrate 41 is capable of controlling temperatures by heating to a specified temperature, and a high-frequency power source 44 is connected to holder 42 so as to apply biased voltage to substrate 41 (See column 1, lines 28-67).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used a conventional plasma treatment device of Tamura et al in Li since Li teaches that a conventional plasma CVD device can be used for plasma treatment.

As to (ii), Tsukune et al teach that a thin film of an organic-group-containing silicon oxide deposited on a wafer by plasma CVD from TEOS and oxygen source (See column 11, lines 43-46) can be converted to silicon oxide by subjecting the thin film to a plasma treatment at high temperature by an oxidation reaction using oxygen or a reduction reaction using hydrogen to remove organic groups from the thin film (See column 12, lines 16-27). In other words, Tsukune et al teach that hydrogen plasma is functionally equivalent to oxygen plasma for converting a film deposited on a wafer by plasma CVD from TEOS and oxygen source to silicon oxide by plasma treatment.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used hydrogen plasma instead of oxygen plasma in Li since Tsukune et al teach that hydrogen plasma is functionally equivalent to oxygen plasma for converting a film deposited on a wafer by plasma CVD from TEOS and oxygen source to silicon oxide by plasma treatment.

It is the Examiner's position that a polymer layer having Si-C bonds deposited by CVD from methyl silane and hydrogen peroxide would harden under heating, and the processed polymer layer of Li in view of Tsukune et al would have claimed properties such as and improved wet etch rate and would include carbon (i.e. Si-C bonds) since it is prepared and processed by the method substantially identical to that of claimed invention (See specification, page 6, lines 3-15).

As to (iii), Li further teach that the ionizing power can be coupled to the gas not only by RF plasma but also by way of inductively coupled plasma as well (See column 5, lines 24-29). In other words, Li teaches that inductively coupled plasma is functionally equivalent to RF plasma for their use as ionizing power.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used inductively coupled plasma concurrently with RF plasma (in RIE mode) for generating hydrogen plasma in Li in view of Tsukune et al since Li teaches that inductively coupled plasma is functionally equivalent to RF plasma for their use as ionizing power.

As to claims 15, 16, 21, Li fails to teach that the polymer film is treated by plasma to a depth of more than 3000 Angstroms (Claim 15) or less than 600 Angstroms (Claim 16) and has thickness of 7000-9000 Angstroms (Claim 21).

One of ordinary skill in the art at would recognize that properties of heat and plasma treated polymer layer would depend on thickness of the layer and the depth of treating the polymer

layer. In other words, thickness and treating depth are result-effective parameters in a polymer treating process.

It is held that it is not inventive to discover the optimum or workable ranges of result-effective variables by routine experimentation. In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). See also In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant thickness and depth parameters (including those of claims 15, 16 and 21) in Li in view of Tsukune et al through routine experimentation in the absence of a showing of criticality.

It is the Examiner's position that in Li in view of Tamura et al and Tsukune et al, the plasma maintained by the wafer support RF driven electrode on which the layer is supported would be generated in a Reactive Ion Etch (RIE) mode (See specification, page 3, P2).

It is the Examiner's position that the processed polymer layer in Li in view of Tamura et al and Tsukune et al would have claimed properties, e.g. the dielectric constant of less than 3.00, reduced cracking and improved wet etch rate, since it is prepared and processed by methods substantially identical to that of claimed invention (See specification, page 6, lines 3-15).

It is held that where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, claimed properties or functions are presumed to be inherent. See MPEP 2111.02, 2112.01. In re Best, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977). "When the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not." In re Spada, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990).

10. Claims 1, 3, 5, 10-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsukune et al in view of Domoto et al (US 6,354,008), Li and Tamura et al.

Tsukune et al disclose a process for forming silicon oxide film comprising placing a wafer 18 such as silicon (semiconductive) wafer (See column 11, line 64) on a lower electrode 16 (claimed platen) having a heater 19 (See Fig. 13; column 17, lines 58-65), depositing a polymer layer of organic-group containing silicon oxide (i.e. including Si-C bonds) (See column 7, lines 37-55; column 18, lines 4-8) by introducing organosilane such as TEOS and H_2O through a pipe 17 in the upper electrode 15 (See Fig. 13; column 18, lines 21-28) on the wafer while heating the wafer at 100-250^{0}C (See column 12, lines 5-10) to accelerate crosslinking (and desorbing moisture) (See column 10, lines 49-56), stopping the supply of the organosilane and generating a plasma through the introduction of gases such as H_2 (See column 12, lines 16-26) and exposing the layer to hydrogen plasma for 5-60 seconds to a thickness of 100 nm (See column 12, lines 37-40) at the same temperature (during the heating process) (See column 12, lines 16-43) followed by a heat treatment at 250^{0}C-450^{0}C (See column 11, lines 29-33). The organic group is removed by the reduction reaction (See column 12, lines 26-27) thereby converting the polymer layer to silicon oxide (See column 12, lines 16-21). Plasma is RF plasma and power source is up to 500 W (See column 14, lines 14-16). A 1 micron thick thin film of an organic-group-containing silicon oxide was deposited with the wafer temperature being varied (See column 18, lines 6-19).

Tsukune et al fail to teach that: (i) RF power source is connected to the electrode supporting the substrate (Claim 1); (ii) the heating step is conducted at temperature up to 550^{0}C (Claims 12, 13, 24) and lasts for 2-4 minutes (Claim 10) or for 3 minutes (Claims 11, 13); the power source is 400-750 watts (Claim 5) or 600 watts (Claim 13); hydrogen plasma is further generated in ICP mode concurrently with RIE mode (Claim 26); (iii) the polymer film is treated

by plasma to a depth of more than 3000 Angstroms (Claim 15) or less than 600 Angstroms (Claim 16), and has thickness of 7000-9000 Angstroms (Claim 21).

As to (i), Domoto et al teach that plasma CVD method, which deposits a film by decomposing a source gas in a plasma (See column 1, lines 44-53), can be carried out either in an apparatus of Fig. 25, where a substrate holder is grounded or in an apparatus analogous in construction to the apparatus shown in Fig. 25, with the exception that a radio-frequency power source 83 is electrically connected to the substrate holder 77 for applying a radio-frequency power to the substrate holder 77 (See column 23, lines 19-27). In other words, Domoto et al teach that the film of the same quality can be deposited in CVD apparatus whether substrate holder 77 is grounded or connected to a radio-frequency power source.

Li teaches that plasma treatment of polymer layer can be carried out in the same plasma CVD apparatus after depositing the polymer layer (See column 5, lines 7-16).

Tamura et al teach that in a conventional plasma treatment device described with reference to FIG. 12 (See column 1, lines 11-19) where a substrate holder 42 supporting a substrate 41 is connected to a high-frequency power source 44, the substrate holder 42 may be provided with heating means for controlling temperatures to a specified temperature (See column 1, lines 28-67).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used an apparatus analogous in construction to the apparatus of Tsukune et al with the exception that a radio-frequency power source is connected to a substrate holder for applying a radio-frequency power to the substrate holder since Domoto et al teach that the film of the same quality can be deposited in CVD apparatus whether substrate holder 77 is grounded or connected to a radio-frequency power source, Li teaches that plasma treatment of polymer layer can be carried out in the same plasma CVD apparatus after depositing the polymer layer, and Tamura et

al teach that the substrate holder may be provided with heating means for controlling temperatures to a specified temperature.

As to (ii), Li teaches that a heat treatment and RF plasma treatment of a polymeric layer deposited on a substrate such as silicon (semiconductive) wafer (See column 1, line 14; column 7, lines 28-29) supported on a pedestal (platen) including heating resistive heating elements (See column 5, lines 60-63) from (TEOS) (See column 6, lines 14-23), may be conducted by heating the polymer layer to temperature of 400^0C -800^0C (See column 5, lines 46-50) to desorb moisture (See column 6, lines 3-5), and exposing the layer to a plasma such as oxygen plasma for 5-90 seconds (See column 5, lines 11-16) during the heating process (See column 5, lines 57-61) using RF power of between about 0.1 kW and 1 kW, more preferably about 0.5 kW applied to the electrodes of a (See column 5, lines 31-37) to obtain the polymer layer having the dielectric constant below 3.00 (See column 6, lines 8-10).

Since Tsukune et al teach that hydrogen plasma is functionally equivalent to oxygen plasma for plasma treatment of a polymer layer deposited on a substrate such as silicon (semiconductive) wafer (See column 12, lines 21-27), it would have been obvious to one of ordinary skill in the art at the time the invention was made to have conducted treating of the polymer layer in Tsukune et al at conditions described by Li depending on particular application with the expectation of providing the desired hardened and crosslinked polymer layer, as taught by Li.

As to claim 26, Li further teach that the ionizing power can be coupled to the gas not only by RF plasma but also by way of inductively coupled plasma as well (See column 5, lines 24-29). In other words, Li teaches that inductively coupled plasma is functionally equivalent to RF plasma for their use as ionizing power.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used inductively coupled plasma concurrently with RF plasma (in RIE mode) for generating hydrogen plasma in Tsukune et al since Li teaches that inductively coupled plasma is functionally equivalent to RF plasma for their use as ionizing power.

As to (iii), Tsukune et al further teach that the step of deposition and the step of plasma treatment are alternately *repeated* in an identical reaction chamber to form a silicon oxide film having a *desired* film thickness on a substrate (See column 2, lines 1-3); and when a film is formed while controlling the film thickness to a small value, the occurrence of the stress can be minimized and a repetition of the formation of a thin film and the heat treatment enables the film thickness to be increased (See column 6, lines 55-68). One of ordinary skill in the art at would recognize that properties of heat and plasma treated polymer layer would depend on the power source wattage, the depth of treating the polymer layer, heating time, temperature, etc. In other words, the power source wattage, thickness and treating depth, etc. are result-effective parameters in a polymer treating process.

It is held that it is not inventive to discover the optimum or workable ranges of result-effective variables by routine experimentation. In re Antonie, 559 F.2d 618, 195 USPQ 6 (CCPA 1977). See also In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have determined the optimum values of the relevant thickness and depth parameters (including those of claims 15, 16 and 21) in Tsukune et al/in view of Domoto et al and Tamura et al through routine experimentation in the absence of a showing of criticality.

It is the Examiner's position that in Tsukune et al in view of Domoto et al, Li and Tamura et al, the plasma maintained by the wafer support RF driven electrode on which the layer is supported would be generated in a Reactive Ion Etch (RIE) mode (See specification, page 3, P2).

It is the Examiner's position that the processed polymer layer in Tsukune et al in view of Domoto et al, Li and Tamura et al would have claimed properties, e.g. the dielectric constant of less than 3.00, reduced cracking and improved wet etch rate, since it is prepared and processed by methods substantially identical to that of claimed invention (See specification, page 6, lines 3-15).

It is the Examiner's position that the polymer layer in Tsukune et al in view of Domoto et al, Li and Tamura et al would still include some or even traces of carbon (i.e. Si-C bonds) because: (i) it is generally impossible to completely remove every possible Si-C bond; and (ii) the treatment of the deposited polymer layer to remove organic groups (i.e. Si-C bonds) from the polymer layer which includes heating to temperature of 250^0C -450^0C (See column 11, lines 32-33) and exposing to H_2 plasma maintained by RF power of 100-500 watts (See column 14, lines 14-16) for 5-60 seconds at the same temperature (See column 12, lines 16-43) is somewhat **milder** than the treatment of claimed invention which includes heating to a temperature of 350^0C -550^0C (See Claims 12, 13) and exposing to H_2 plasma maintained by RF power (Claim 4) of 400-750 watts (Claims 5, 7, 9) for 2-4 minutes at the same temperature (See Claims 10, 11, 13) so that plasma treatment under conditions of Tsukune et al would remove *less* organic groups (i.e. Si-C bonds) from the polymer layer than the treatment of claimed invention.

11. The prior art made of record and not relied upon is considered pertinent to applicant disclosure.

The following references show that in plasma CVD apparatuses plasma source is connected to a substrate electrode:

Blum et al (US 5,133,986), See column 3, lines 10-15.

Obata et al (US 5,930,077), See column 4, lines 16-18.

Grill et al (US 5,981,000), See column 3, lines 8-9, 23-24.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Elena Tsoy whose telephone number is (571) 272-1429. The examiner can normally be reached on Mo-Thur. 9:00-7:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-141523. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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July 14, 2005